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ABSTRACT

A study focused on the appropriate balance between academic and vocational education for those who intend to work rather than attend college after graduation. Two hypotheses were tested: (1) a high school curriculum that completely specializes in vocational education and ignores basic skills training will not be as effective as the one that provides both, and (2) for the non-college-bound student, vocational and academic education are complements rather than substitutes. This study used a subsample of the High School and Beyond data--students who graduated from high school in 1980 and did not attend college full time between June 1980 and February 1982. A preliminary analysis of the data was based on the cross tabulations of the three indicators of economic productivity--wage rate, number of months employed between 1980 and 1982, and earnings in 1981--by the number of vocational and academic courses taken. These tabulations suggest that vocational and academic courses may be complementary. An econometric specification of the model based on this observation allowed estimation of the degree of complementarity and the degree of decreasing returns from vocational and academic course work. Results showed that taking additional vocational courses is associated with small cutbacks in academic courses taken, but substantially high wage rates, employment, and earnings in the 18 months following graduation. It was concluded that a modest level of vocational course work produced greater benefit than total academic specialization, but taking more than three or four vocational courses sharply diminishes this benefit. (YLB)

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VOCATIONAL AND ACADEMIC EDUCATION IN HIGH SCHOOL: COMPLEMENTS OR SUBSTITUTES

Working Paper 88-10

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VOCATIONAL AND ACADEMIC EDUCATION IN HIGH SCHOOL: COMPLEMENTS OR SUBSTITUTES

I. Introduction

A number of blue ribbon-panels have called for increases in the number academic courses required for graduation from high school and for lengthening the school day and the school year. Most states have adopted the first of these recommendations but not the second. With the amount of time a student spends in school remaining constant, increases in the number of required academic courses force reductions elsewhere. Which activities should be reduced? Should the reduction be made in study halls, music and fine arts, physical education, and life skills courses or should it come in vocational education? The answer to this question will not be the same for every student. High school graduates who do not want to go to college and plan to work immediately after graduating probably have very different feelings about course selection than a student who aspires to being an artist.

The fact that vocational courses were conspicuously absent from Secretary Bennett's James Madison High School model curriculum suggests that some policy makers may even be contemplating the removal of many vocational programs from high schools altogether and their concentration instead at post secondary institutions. A Research Triangle Institute report (Cox 1986) made such a proposal to the state of North Carolina in 1986.

Since a number of the reports justify their recommendations for more required academic courses by citing the need for a more productive workforce, it is useful to know how course selection in high school influences indicators of productivity such as wage rates, yearly earnings and employment. In this paper we will focus on the appropriate balance between academic and vocational education for those who intend to work rather than attend college after graduation.

There have been quite a few studies of the impact of high school vocational education on the labor market success of those who choose not to go to college. Most of the early studies used student reports of their track to define participation in vocational education (Grasso and Shea 1981, Gustman and Steinmeier 1981, Woods and Haney 1981). When, however, these student reports of track were cross checked against transcripts, it was found that some of the self-identified vocational students had only a few vocational

courses on their transcript and many "general track" students had taken 3 or 4 vocational courses (Campbell, Orth and Seitz 1981). Since it is the number and types of courses taken which are influenced by school policy, studies of the impact of vocational education need to employ objective measures of participation not self assessments of track which apparently measure the student's state of mind as much as they measure the courses actually taken.

The solution to this problem adopted by Paul Campbell and his colleagues at the National Center for Research in Vocational Education has been to use high school transcripts to determine which students pursued an academic curriculum and which students pursued a vocational concentration. Once the classification was made, 0-1 dummy variables were defined for students who pursued an academic program and for three different patterns of vocational participation. Controlling for test scores and past and present enrollment in higher education, their analysis of 1983 National Longitudinal Survey data on 6953 young men and women found that vocational graduates were 8.2 percent more likely to be in the labor force and were 3.5 percentage points less likely to be unemployed than the graduates who pursued an academic curriculum. In the current or most recent job, monthly pay was 5.6 percent higher in 1983 and 2.2 percent higher in 1985. A parallel study of 6098 members of the class of 1982 cohort of High School and Beyond found that controlling for test scores and college attendance that the vocational graduates were 14.9 percent more likely to be in the labor force in 1983/84, were one percentage point less likely to be unemployed and were paid about 9 percent more per month than the academic grads.' The differential between vocational and general curriculum graduates [who generally took 1 to 2 vocational courses] was generally about half the size of the differential between vocational and academic graduates.

Other researchers have chosen to specify various kinds of vocational and academic course work as continuous variables which are assumed to have linear and additive effects on labor market outcomes. In his analysis of longitudinal data on approximately 3500 seniors from the Class of 1972, Meyer (1981) used school reports of the number of courses taken in vocational and nonvocational fields to define a continuous variable: the share of courses that were vocational. He found that females who devoted one-third of their high school course work to clerical training earned 13 percent more during the seven years following graduation than those who took no vocational courses.

Those who specialized in home economics or other non-clerical vocational courses did not obtain higher earnings. Males who specialized in trade and industry earned 2.8 percent more than those in the general curriculum. Males in commercial or technical programs, did not earn significantly more than those who pursued a general curriculum.

Rumberger and Daymont (1982) used transcripts to define variables for the share of course work during the 10th, 11th and 12th grades that was vocational and the share that was neither academic nor vocational. Analyzing 1979/80 data on 1161 young adults in the National Longitudinal Survey who were not attending college full time, they found that males who devote one-third of their time to vocational studies instead of pursuing a predominantly academic curriculum spent about 12 percent more hours in employment, but experienced slightly greater unemployment and received a 3 percent lower wage. Females who similarly devoted one-third of their time to vocational studies at the expense of academic course work were paid the same wage but spent about 8 percent more time in employment and 1.6 percent less time unemployed.

In their study of 2485 High School and Beyond seniors who did not attend college full-time, Kang and Bishop (1986) used student reports of courses taken in three different vocational areas--business and sales, trade and technical and other--and five academic subjects--English, math, science, social science and foreign languages--as measures of curriculum. Males who took 4 courses (about 22 percent of their time during the final three years of high school) in trade and technical or other vocational subjects by cutting back on academic courses were paid a 7 to 8 percent higher wage, worked 10 to 12 percent more and earned 21 to 35 percent more during 1981, the first calender year following graduation. Males who took commercial courses did not have higher earnings or wage rates. Females who substituted 4 courses in office or distributive education for 4 academic courses were paid an 8 percent higher wage, worked 18 percent more and earned 40 percent more during 1981. Females who took trade and technical courses did not receive higher wage rates and earned only slightly more than those who pursued an academic curriculum.

These three studies speak to the question of whether high school vocational education should be discontinued, but not to the optimal intensity of a vocational program. All three made the simplifying assumption that credit hours (or proportions of total credit hours) have a constant linear

additive impact on labor market outcomes. Under this assumption, a finding that 4 trade and technical courses is a good idea implies that 12 courses in that field is an even better idea (in fact three times as good). While vocational programs approach this intensity in other nations, most American educators would blanch at such a proposal. In this paper we relax and then test the two assumptions--(1) the marginal payoff to courses in a particular field is not subject to diminishing returns and (2) the marginal payoff to courses in one field is unaffected by courses taken in other fields--that produce this rather counter intuitive prediction. We hypothesize, instead, that a high school curriculum which completely specializes in vocational education and ignores training in basic skills will not be as effective as the one that provides both vocational skills and a certain level of basic skills. While specializing solely in academic courses may be appropriate for those planning to attend college full time, we hypothesize that for those not going to college, academic specialization will generally mean a sacrifice of earnings and employment in the years immediately following high school graduation. In other words, we hypothesize that for the non-college-bound student that vocational and academic education in high school are complements rather than substitutes.

The paper tests these hypotheses by analyzing two waves of questionnaire data obtained from the High School and Beyond (HSB) Survey on 1980 high school graduates who did not attend college full time. An outline of the paper is as follows. The High School and Beyond data is described in Section Two. The first part of Section Three presents a preliminary analysis of the data based on the cross tabulations of the three indicators of economic productivity--wage rate, employment and earnings--by the number of vocational courses taken and the number of academic courses taken. These tabulations suggest that vocational and academic courses may be complementary. Based on this observation an econometric specification of the model is presented in the second part of the section. The model allows estimation of the degree of complementarity and the degree of decreasing returns from vocational and academic course work. Section Four discusses the results and presents estimates of how time should be distributed between academic and vocational courses if one's goal is maximizing the individual's economic productivity immediately after high school. The policy implications of the results are

discussed in Section Five.

II. Data

Longitudinal data on the 1980 seniors completing the High School and Beyond (HSB) survey will be analyzed. The first wave of data collection occurred in March/April of 1980 while the young people were seniors in high school. The second wave of data collection was conducted in the spring of 1982 nearly 2 years after graduation from high school. The first wave contains various measures of education and grades in school, nonacademic activities such as participation in extracurricular activities, and work experience, as well as the students' family background, attitudes toward work, and career aspirations. At the time of the first wave survey, all respondents took standardized tests on three subjects, mathematics, reading, and vocabulary. These tests provide measures of the level of the basic skills which are comparable across respondents. The second wave contains a complete history of jobs held since 1980 and post high school educational experiences and earnings. Three measures of the respondents' labor markets success--earnings in 1981, number of months in which the respondent worked in the period between June 1980 and February 1982, and average wage rates during the 21-month period--were defined from the second wage interview.

Longitudinal data is available on a total of about 12,000 seniors. The subsample of this group was selected for this study by applying the following criteria: respondents had to have.

(1) Graduated from high school in May or June 1980 and

(2) not attended school or college full time at anytime between June 80 to February 82.

The total number of observations that satisfy these selection criteria is 4,327. In the regression analysis the observations are further reduced by the omission of observations with certain key variables missing.[2]

These selection criteria and elimination of the observations with missing values reduced the total number of observations to 2,576 for earnings in 1981, to 2,485 for number of months worked, and to 2,058 for wage rates (see Appendix). The labor market outcomes examined in the study are 1981 earnings; the number of months in which the individual worked between June 1980 and February 1982, and the average hourly wage rate during that period (see

Appendix). These variables measure the labor market experiences that immediately follow high school graduation. Transcripts are not available for the HSB seniors, so data on what the youth studied in high school was obtained by asking the student to report how many years of courses he or she took in each of the following fields: mathematics, English or literature, French, German, Spanish, history or social science, science, business or sales, trade and industry, technical and other vocational. In the analysis, the foreign languages were aggregated together and technical vocational programs are combined with trade and technical.

Controls were included for the following: test scores, High school GPA, grades in business/office courses, grades in all other vocational courses, geographic region, sex, race, ethnicity, age, parental education, family income, siblings, physical handicaps, hours spent doing homework, participation in extracurricular activities, working for pay during high school, discipline problems in high school, reads newspapers and books for pleasure, current marital status, part-time enrollment in college, active military service, and psychological scales for self esteem, locus of control, work orientation, family orientation and community orientation. A detailed list of the variables is given in the Appendix along with the sample means and standard deviations of the key variables describing curriculum and basic skills achievement for males and females separately and for the full sample.

Mean earnings in 1981 for the whole sample was $5,490. On average they were employed 12.5 months during 21-month period between June 80 and February 82, and their average hourly wage during that period was $4.20. In all three categories of labor market outcomes, males did better than females. Males earned an additional $2,734 per year, worked an additional 1.8 months, and were paid 66 cents more per hour than females.

Male and female high school graduates who do not go to college full time take similar numbers of courses in math, English, history, and science. The young women are more likely to study a foreign language and to take courses in business and office education. They average 1.46 years of business office education while young men average .63 years. Young men took an average of 1.56 years of trade, industrial, and technical courses while women took an average of .3 years.

III. Model

Preliminary Analysis

Tables 1 and 2 present data on the gross relationship between curriculum and labor market success. Table 1 shows the mean values of the number of academic courses taken and the three labor market outcomes for subsamples classified by the self-reported number of full-year courses taken in vocational subjects during the final three years of high school. Note that the number of academic courses taken (column 1) shows only a weak tendency to decrease as the number of vocational courses increases. This implies that the time devoted to vocational courses comes primarily at the expense of study halls, free time, and courses classified as neither academic nor vocational such as art, music, drivers education, and physical education. The table clearly demonstrates that high school graduates not attending college full time who took a vocational concentration in high school have higher wage rates, work a greater number of months, and earn a great deal more in the year or so after graduating than the 30 percent of such graduates who took fewer than 2 such courses. Students who took 4 full years of vocational courses received 8 percent higher wage rates, worked 23 percent more, and earned 47 percent (about $2000) more in 1981 than students who took less than 2 vocational courses.

Table 2 classifies the graduates by the number of academic courses taken. There is a mild tendency for the number of vocational courses to decline as academic course work rises. The graduates who obtain the most favorable labor market outcomes are those who take 6 to 7.5 full-year academic courses. The 15 percent who took fewer academic courses have about the same wage but work less and earn 5 to 10 percent less. Graduates who took 10 or 11 academic courses received a 3 percent lower wage, worked 11 percent less and earned 18 percent less than those taking 6 to 7.5 academic courses.

Tabulations of the labor market outcomes by the total number of academic and vocational courses (not shown) revealed a positive relationship. Non-college-bound students who took 16 or more academic and vocational courses during their final three years in high school met with greater labor market success than students who took fewer than 10 such courses. The group taking more courses received a 7 percent higher wage rate, earned 24 percent more

TABLE 1

IMPACT OF VOCATIONAL COURSEWORK ON LABOR MARKET OUTCOMES
OF HIGH SCHOOL GRADUATES WHO DO NOT ATTEND COLLEGE FULL TIME

		Outcomes		
Number of full year vocational courses	Number of full year academic courses	Wage	Percentage of months worked in 21 months	Earnings in 1981
none - .5 (12%)	9.49	4.10	48.5	4031
0.5 - 1.0 (18%)	9.30	3.89	54.8	4526
1.5 - 2.0 (27%)	9.00	4.17	59.5	5470
2.5 - 3.0 (18%)	8.81	4.28	60.9	5606
3.5 - 4.0 (13%)	8.71	4.29	64.8	6334
4.5 - 5.0 (7%)	8.57	4.22	66.2	6421
5.5 - 6.0 (5%)	8.69	4.61	64.3	6471
6.5 - 7.0 (2%)	8.98	4.21	61.9	6893
7.5+ (3%)	9.19	4.80	60.0	6968

TABLE 2

IMPACT OF ACADEMIC COURSEWORK ON LABOR MARKET OUTCOMES
OF HIGH SCHOOL GRADUATES WHO DO NOT ATTEND COLLEGE FULL TIME

Number of full year academic courses	Number of full year vocational courses	Outcomes		
		Wage	Percentage of months worked in 21 months	Earnings in 1981
- 3.5 (4%)	2.04	4.31	52.5	5300
4 - 5.5 (11%)	2.82	4.26	63.0	5777
6 - 7.5 (26%)	2.92	4.27	62.9	6083
8 - 9.5 (28%)	2.68	4.19	57.4	5290
10 - 11.5 (20%)	2.42	4.13	56.2	4998
12 - 13.5 (8%)	2.30	4.11	57.5	5226
14+ (3%)	1.82	4.06	60.3	4381

income, and worked 2 percent more than those taking fewer than 10 courses.

These observations suggest the following:

- Provided students take a certain amount of academic courses, the number of vocational courses taken improves labor market outcomes.
- The effect of academic courses declines as students take more of them. The decline is accelerated if the increase in academic courses is accompanied by fewer vocational courses.

Econometric Specification of the Model

A standard linear additive specification of the effect of academic and vocational course has the following form:

$$(1)\quad y = a\Sigma A_i + b\Sigma V_j + g_k Z_k + u,$$

where y is a vector of labor market outcomes (earnings, employment and wages),

A_i is the number of full-year courses taken in the ith academic subject,

V_j is the number of full-year courses in the jth vocational subject,

Z_k is the vector of other control variables such as grades, level of basic skills (mathematics, vocabulary, and readings) and socioeconomic, and background variables, and

u, is the disturbance term.

While we will begin by estimating (1), we also need an econometric specification which tests for (a) differential effects of academic and vocational education by subject, (b) interactions between academic and vocational education, and (c) diminishing returns to both kinds of education. We, therefore, hypothesize the following relation between the labor market outcomes and curriculum:

$$(2)\quad y = \underline{a}_i A_i + \underline{b}_j V_j + c\ TA2 + d\ TV2 + f\ TAVX + g_k Z_k + u_2$$

where TA2 is the sum of all academic courses taken squared $TA2 = (\Sigma A_i)^2$,

TV2 is the sum at all vocational courses taken squared $TV2 = (\Sigma V_j)^2$,

TAVX is the product of total academic course work and total vocational course work $TAVX = (\Sigma A_i)(\Sigma V_j)$,

The specification in equation (2) allows estimation of the differential effects of vocational and academic course work by using separate measures of vocational and academic courses by subject. In addition, by introducing the squared terms (TA2, TV2) and the interaction term between academic and

vocational courses (TAVX), it is possible to estimate degrees of decreasing (or increasing) return from and of complementarity (or substitutability) between the academic and vocational courses. For example, the marginal return from the additional academic course in the i th field is given by equation (2) as follows:

$$(3) \quad \partial y/\partial A_i = a_i + 2cTA + fTV$$

Equation (3) says that the marginal effect of the i th academic course depends on the coefficients for square term, c, and for interaction term f. When c is negative the marginal effect of academic courses decrease with the total amount of academic courses (decreasing returns), and when f is positive, the marginal effect of the academic course work increase if the vocational course work is increased. The marginal return from an additional vocational course in the j th field is given by equation (4).

$$(4) \quad \partial y/\partial V_j = b_j + 2dTV + fTA$$

If f is positive, academic and vocational courses will be termed complements. If f is negative, they can be called substitutes. Academic (vocational) education has increasing returns if c (d) is positive and has decreasing returns if c (d) is negative. Estimates of these coefficients make it possible to calculate what distribution of courses between academic and vocational subjects will maximize the measures of success in the labor market immediately after high school.

IV. Results

The three labor market outcomes examined in this study are earnings in 1981, number of months in which the individual worked between June 1980 through February 1982, and average hourly wage rate during the period. As a preliminary approach we regressed the three measures of labor market outcomes on the total amount of academic education and the total amount of vocational education along with a long list of control variables (see Appendix). The estimates of the coefficients on total academic courses and total vocational courses are presented in the columns of tables 3 and 4 which have (1) at their head. The estimated effects of vocational education are all positive. The coefficients are significantly positive at the 1-percent level in the earnings equation for both males and females, and are significant at the 5-percent

Table 3

CURRICULUM EFFECTS ON LABOR MARKET OUTCOMES OF MALES

	Earnings		Employment		Wage Rates	
	(1)	(2)	(1)	(2)	(1)	(2)
Vocational Courses						
Total	258***	--	.175*	--	.073***	--
	(69)		(.101)		(.025)	
Total Squared	--	-30	--	-.029		.004
		(22)		(.029)		(.007)
Trade & Technical	--	3	--	.653	--	-.096
		(299)		(.432)		(.107)
Business and Sales	--	-92	--	1.093**	--	-.095
		(355)		(.517)		(.128)
Other Vocational	--	324	--	.753	--	-.126
		(320)		(.466)		(.113)
Academic Courses						
Total	-30	--	-.101	--	-.008	--
	(60)		(.092)		(.022)	
Total Squared	--	-16	--	-.009	--	.006
		(16)		(.023)		(.005)
Mathematics	--	310	--	.269	--	-.124
		(332)		(.478)		(.117)
English	--	272	--	-.405	--	-.010
		(320)		(.460)		(.115)
Foreign Language	--	204	--	.305	--	-.226
		(397)		(.574)		(.142)
Social Science	--	117	--	-.043	--	-.217*
		(335)		(.486)		(.120)
Science	--	-43	--	.425	--	-.216*
		(357)		(.517)		(.129)
Vocational x Academic		41*		-.033		.014*
		(25)		(.036)		(.008)
R Square	.159	.173	.145	.161	.130	.149
Number of Observations	1195		1130		942	
Mean of Dependent Var.	6956		13.47		4.56	
SD of Dependent Var.	5429		7.62		1.65	

Standard errors are in parenthesis beneath the coefficient. * means significant at .10 on a two tail test. ** means significant at .05 on a two tail test. *** means significant at .01 on a two tail test.

Table 4

Curriculum Effects on Labor Market Outcomes of Females

	Earnings		Employment		Wage Rates	
	(1)	(2)	(1)	(2)	(1)	(2)
Vocational Courses						
Total	164***	--	.297***	--	.018	--
	(58)		(.110)		(.017)	
Total Squared	--	-35*	--	-.100**	--	.002
		(22)		(.041)		(.006)
Trade & Technical	--	658**	--	1.476***	--	-.103
		(257)		(.490)		(.098)
Business and Sales	--	609*	--	1.624***	--	-.000
		(317)		(.613)		(.081)
Other Vocational	--	596**	--	1.539***	--	-.066
		(271)		(.518)		(.085)
Academic Courses						
Total	-215***	--	-.320***	--	-.035***	--
	(40)		(.077)		(.013)	
Total Squared	--	7	--	-.031*	--	.001
		(10)		(.018)		(.003)
Mathematics	--	-271	--	.354	--	.002
		(231)		(.441)		(.076)
English	--	-176	--	073	--	.019
		(207)		(.393)		(.069)
Foreign Language	--	-297	--	.932**	--	-.023
		(242)		(.466)		(.079)
Social Science	--	-422*	--	.275	--	-.170**
		(228)		(.435)		(.073)
Science	--	-206	--	.344	--	-.002
		(236)		(.451)		(.077)
Vocational x Academic	--	-24	--	-.064	--	.006
		(21)		(.040)		(.007)
R Square	.208	214	.247	.256	.080	.099
Number of Observations	1381		1355		1116	
Mean of Dependent Var.	4223		11.16		3.90	
SD of Dependant Var.	3981		7.71		1.00	

Standard errors are in parenthesis beneath the coefficient. * means significant at .10 on a two tail test. ** means significant at .05 on a two tail test. *** means significant at .01 on a two tail test.

level in the months worked equation for females, and in the hourly wage equation for males. The coefficients on academic course work are all negative. The coefficients are all significantly negative at the 1-percent level for females but insignificant for males. These results imply that the balance between academic and vocational education does indeed have a strong influence on labor market outcomes. Substituting 4 vocational courses for 4 academic courses raises earnings by 17 percent for males and by 36 percent for females. The regressions predict that taking 8 vocational courses would have twice as large an effect.

The estimates in these regressions, however, do not capture the differential effect of course work in a particular subject within vocational or academic education. Also, it is unlikely that the insignificance of academic education for males, and strong negative effect of academic courses for females prevail over the full range of possible variation in course work. Further, the positive effect of vocational education may change as the level of academic education varies.

In order to see differential effects of the subjects in vocational and academic education, we introduce the number of full-year courses in the five subject groups within academic courses (mathematics, English, foreign language, history and social science, and science) and in the three subjects groups within vocational courses (business and sales, trade and technical, and other vocational courses).

In order to approximate the nonlinear relation, we include the quadratic terms for total academic and total vocational courses and an interaction term between the two. The three labor market outcomes are regressed on the curriculum variables, along with the scores on standardized tests (mathematics, reading, and vocabulary), grades, and a large group of control variables. The control variables included: dummies for nine census regions, residence in a suburb, rural, or urban area, family background, scales measuring self esteem, locus of control, work orientation, family orientation, community orientation, church attendance, school attendance, reading habits, homework, deportment, participation in extra curricular activities and in noncredit educational programs, work experience while in high school, marital status, and military status. We tested for gender differences in slopes using a Chow test. Significant gender differences were found, so separate models

were estimated for males and females.

Marginal Effects of the Types of Courses Taken

The estimation results are given in the columns of tables 3 and 4 which have (2) at their head. Our main interest is in the marginal effects of academic and vocational course work. The results are analyzed first by looking at the estimates of the marginal returns from education that are given by the linear combinations of coefficients.

The coefficients on the square of academic course work and the square of vocational course work provide an estimate of the degree of diminishing returns. The coefficients on the square are negative as hypothesized in the months worked regressions and three of four coefficients are negative in the earnings equations. Three of these coefficients are significantly negative. In the female months worked equation the coefficient estimates are significantly negative for both of the squared terms, and in the female earnings equation the marginal return from vocational courses is significantly decreasing. Only one of the four coefficients on square terms in the wage rate regression are negative but all of them are very close to zero.

It was hypothesized that academic and vocational courses are complementary. Two of the six estimated coefficients are significantly positive as hypothesized. The hypothesis of complementarity is accepted for the earnings and the wage rates of males.

Table 5 presents estimates of the impact of one more course in each specific field of study. The marginal return from the i th academic course is given by $a_i + 2c \cdot TA + f \cdot TV$ and the marginal return from the j th vocational course is $b_j + 2d \cdot TV + f \cdot TA$. As we can see from these equations the marginal return changes with the levels of total academic courses (TA) and total vocational courses (TV) so the estimates of the marginal returns reported for each subject area have been evaluated at the sample means for the total number of academic and vocational courses. The sample means of TA are about 9 for both females and males and the means of TV are 2.9 for males and 2.4 for females. The entries in the table show that the marginal returns to vocational education are positive for both females and males with the exception of the trade and technical and other vocational courses' impact on the wage rates of females. The magnitudes of the marginal effect from each

TABLE 5

POINT ESTIMATES OF THE
MARGINAL RETURN FROM COURSE WORK BY SUBJECT

	Wage Rate		Total Months Worked		Earnings in 1981	
	Male	Female	Male	Female	Male	Female
Academic Courses						
Mathematics	.026	-.109	.009	-.355	140	-204
English	.140	-.092	-.665	-.636	102	-109
Foreign Language	-.076	-.134	.045	.223	34	-230
Social Science	-.067	-.281	-.303	-.434	-53	-355
Science	-.066	-.109	.165	-.365	-213	-139
Change in Marginal return by						
Academic Courses	.012	-.014	-.018	-.062*	-32	14
Vocational Courses	.014*	.006	-.033	-.064	41*	-24
Marginal Return from Vocational Courses						
Business/Sales	.012	.063	.623	.421	104	275
Trade/Technical	.401	-.040	.183	.569	199	226
Other Vocational	.155	-.003	.283	.484	523	213
Change in Marginal return from						
Academic Courses	.014*	.006	-.033	-.064	41*	-24
Vocational Courses	.008	.004	-.058	-.200*	-60	-70*

subject vary by the measures of labor market success.

For men, the point estimates in the earnings equation apparently imply that the highest returns come from taking other vocational courses and the next highest returns come from taking trade and technical courses. Trade and technical courses seem to be most effective in raising the wage rate but have very little impact on employment. Business and sales courses seem to have the opposite effect; they help male students get and keep jobs but their effect on the wage rate is minimal.

For females, the marginal effects of vocational subjects do not vary much with particular subjects. Point estimates for the impact of 1 year of course work range from 0.42 to 0.57 months for employment and from $213 to $275 for earnings.

The changes in the marginal returns due to additional vocational and academic courses are given in the second and fourth panel of table 5. The asterisk ("*") indicates that the changes are significantly different from zero at the 10-percent level. The impact of vocational education on earnings and employment decreases as students take more courses in vocational education and the effects are statistically significant for females (see the second row in the fourth panel). Each additional year of vocational education lowers the return to the next year of vocational education by $70 in the earnings model and by 1/5 month in the employment model. For males, the impact of vocational education on wage rates and earnings significantly increases as the number of academic courses increases (see row 4 of the second panel).

The marginal returns from academic courses are mostly negative for females, and the greater the number of academic courses the more negative these effects become. For females, an additional unit of academic course work reduces the marginal effect of academic education by 0.06 month. For males, the marginal effects of mathematics are positive for all three indicators of labor market success. English courses have positive effects on wage rates and earnings.

Prediction of the Earnings by the Levels of Academic and Vocational Courses

The above results imply that academic and vocational course work have curvilinear impacts on labor market success. Consequently, it is desirable

for high school students who are not planning to attend college to combine vocational and academic course work. In this subsection we use the estimated coefficients from the earnings equation to calculate an ideal combination of academic and vocational education that maximizes earnings in the calendar year following graduation.[3] The comparisons are made between the predicted values of earnings when students take the earnings maximizing combination of academic and vocational courses, and when the students take a "typical" combination of academic and vocational courses, which are given by sample mean values for various levels of total courses. The limitations of this concept of an earnings maximizing combination of courses need to be emphasized. First, it is defined in terms of the predicted earnings in the short-run (the period of 6 to 18 months after leaving high school) for students whose highest education is high school. The combination that maximizes earnings in the short-run may not be the best one in the long run. Second, the computation assumes that the relative weights of the subjects within the academic and vocational fields are fixed at their current level. Shifts of relative weights within academic and vocational fields may change the ideal combination. Finally, the errors in the predicted earnings and the combination that maximizes earnings increase as the constraint on total number of courses diverges from sample mean values. These errors are unavoidable because of the errors in the coefficient estimates and because of approximation error in the functional form.

Table 6 shows the results of the comparisons for both males and females. The first column gives the total number of full-year courses. The second and third columns show the number of vocational courses which maximizes earnings and the level of earnings that is predicted when that combination is chosen. When students choose the earnings maximizing combination of academic and vocational courses, an increase in the number of courses from 8 to 16 raises predicted yearly earnings by $944 ($6,938 to $7,882) for males and $624 ($4,422 to $5,046) for females. It appears that for men (women) who take a total of 12 courses, earnings in the calendar year after high school are maximized when approximately 36 (48) percent of academic and vocational course are vocational. The fourth column gives the average number of vocational courses taken by the students who do not go to college. On average, the vocational share of academic and vocational courses was only about 23 percent considerably below the earnings maximizing level. The fifth column shows the

TABLE 6

INCOME MAXIMIZING COMBINATION OF
ACADEMIC AND VOCATIONAL EDUCATION

Number of courses in years	Income maximizing vocational courses (in years)	Predicted income at more maximizing mix of courses	Typical vocational courses (in years)	Predicted income max mix is reduced to typical	Predicted decline if income max mix is reduced to half of typical mix
Male					
8	2.68	$6,938	1.40	-$143	-$342
10	3.52	$7,182	2.05	-$189	-$543
12	4.36	$7,421	2.82	-$207	-$758
14	5.21	$7,654	3.71	-$193	-$974
16	6.04	$7,882	4.72	-$152	-$1179
Female					
8	4.62	$4,422	1.44	-$417	-$626
10	5.21	$4,680	2.00	-$423	-$727
12	5.79	$4,870	2.64	-$409	-$822
14	6.38	$4,992	3.36	-$375	-$907
16	6.96	$5,046	4.16	-$323	-$980

differences between the predicted income at the earnings maximizing mix of vocational and academic courses and the income for someone who takes the average amount. Because of diminishing returns, the gain from increasing vocational courses from their current average level is not large. The gain in earnings that results depends on the total number of course taken and ranges between $143 and $207 for males and from $323 to $423 for females. Column 6 presents the effect of reducing vocational courses to half of the average level. When vocational courses are cut in half, predicted earnings decline drastically, especially when the number of total courses is large. If the total number of courses is 10, the decline in earnings is $543 for males and $727 for females. If the total course load is 14, the predicted earnings reduction is $974 for men and $907 for women.

V. Summary and Implications

The paper has examined the relative impact of high school academic and vocational education on the labor market success of non-college-bound youth. Cross tabulations of longitudinal data on HSB sophomores revealed that taking additional vocational courses is associated with modest increases in the total number of courses taken and only small cutbacks in the number of academic courses taken. It is also associated with substantially higher wage rates, employment and earnings in the 18 months following graduation. Taking more than the average number of academic courses was associated with slightly lower earnings. Simultaneous increases in both vocational and academic courses were associated with higher earnings.

The regression analysis did not change these findings. The estimates from the simple linear model imply that substituting four extra vocational courses for four academic courses increased a male's wage rate by 7.1 percent, months employed by 8.2 percent, and earnings by 16.6 percent. For females the increases were 5.4 percent for wage rates, 22 percent for months worked, and 36 percent for earnings.[4]

However, complete specialization in vocational education which ignores the training in basic skills is not as effective as a curriculum that provides both vocational skills and competency in basic skills. Estimation of the quadratic specification of the model found that the effect of additional vocational (academic) course work decreases if the level of academic

(vocational) course work is kept constant and the marginal effect of vocational education is higher if the amount of academic course work is increased and vice versa. These estimates suggest that there are decreasing returns from specialization and that a complementarity exists between academic and vocational education. In other words, students who choose to take some modest level of vocational course work benefit greatly relative to those who specialize totally in academic courses, but once 3 or 4 are taken, the benefits of additional vocational courses sharply diminish.

The clear policy implication of this result is that (a) every student who does not have definite plans to attend college full time should be urged to take 3 or 4 courses in an occupational specialty and (b) that vocational students should be counseled against taking an excessive number of vocational courses.[5] The first year earnings benefit predicted by the quadratic model from substituting a four course vocational program for an equivalent number of academic courses are presented in Table 7. These benefits are very large. For example, a business program raises a young women's earnings by $1940 or 40 percent and a trade or technical program raises a young man's earnings by $1536 or 22 percent. The benefits probably diminish in later years but this is of little consequence for at this rate the incremental costs of four vocational courses can be recovered in just one or two years. These very positive results contrast markedly with the very negative findings regarding CETA's classroom occupational skills training programs for youth and the Supported Work Demonstration (see Table 7). Only the Job Corps, a considerably more costly program, has positive impacts that even approach these results.

These findings regarding the payoff to trade & industrial programs and to technical programs also contrast markedly with the more pessimistic findings of the pre 1983 studies of vocational education, two of which are summarized in Table 7. The findings reported in this paper are, however, consistent with the recent work of Paul Campbell and his colleagues on the issue. In their work three distinct patterns of participation are defined: Concentrators who take 6.3 occupational [as distinct from exploratory] vocational courses on average, Limited-Concentrators who take an average of 3.3 occupational vocational courses and Concentrator/Explorers who take an average of 2.6 occupational vocational courses. Their study of the sophomore cohort of HSB

Table 7

THE EARNINGS IMPACTS OF OCCUPATIONAL TRAINING
A Comparson of Studies

High School Vocational Education

Post 1983 Studies

Kang/Bishop-1981		
Women:	Business	$1940 (46%)
	Trade & Tech.	$1744 (41%)
	Other	$1692 (40%)
Men:	Business	$1156 (17%)
	Trade & Tech.	$1536 (22%)
	Other	$2820 (41%)
Campbell et al		
	NLS-1983	$ 933 (17%)
	HSB-1983	--- (27%)

Pre-1983 Studies

		Avg 73-79	1973
Meyer-1973 to 1979			
Women:	Business	$ 410 (16%)	$ 426
	Tech.	$ -72 (-2%)	$ -37
	Home Ec.	$-248 (-5%)	$ 118
Men:	Business	$ 106 (1%)	$ 86
	Trade & Ind.	$ 201 (3%)	$ 493
	Other Tech.	$ 94 (1%)	$ 491
Rumberger/Daymont-1979			
Women		--- (8%)	
Men		--- (10%)	

CETA Classroom Training

Comparison Group Methodology

Bassi et al	
Young Women	$-302
Young Men	$-874
Dickinson et al	
Young Women	$ 117
Young Men	$-565

Supported Work Demonstration

Control Group Methodology

Fraker/Maynard	
Disadv. Youth	$ -18
Women on Welfare	$ 351

Job Corps

Comparison Group Methodology

Maller et al.	
First Year	$ 515
Second Year	$ 667
Third Year	$ 652
Fourth Year	$ 787

The Kang/Bishop estimates are based on the quadratic model and assume the individual goes from zero to 4 vocational courses and reduces academic courses from 12 to 8, with the reduction occurring in the following subjects: math, foreign language, science, and social science. Campbell et al. (1986, 1987) results are a weighted average for all three patterns of participation that combine those who found training related jobs with those who did not. Meyer (1982) and Rumberger/Daymont (1982) results are calculated by multiplying the coefficient on the proportion of courses that is vocational by .33. The CETA estimates are taken from Barnow's (1987, Table 3) review of the literature and are a simple average of results for white and minority youth. The Supported Work result is from Table 5 of Fraker/Maynard (1987). The Job Corps estimate includes both civilian and military jobs and uses non-linear time trends (Maller et al. 1982 p. ix). The estimated effects are reported in current dollars. The dates reported are the year of the earnings data. Since the studies analyze data from different years, comparisons between studies may be influenced by differences in the general level of wages.

found that substituting a weighted average of these three vocational programs for an academic program raised earnings during the first year after graduation by 27 percent on average for both men and women [comparison is made with academic rather than general track students because most general track students take one or two vocational courses]. Their study of 19 to 28 year olds in the NLS found that taking a vocational program rather than an academic program had increased 1983/85 earnings by 16.5 percent.

In our view, these more recent studies provide a more accurate description of the current impacts of vocational education than the studies published prior to 1983. There are four reasons for this view. First, vocational education has been changing rapidly. During the 1970s competency based instruction tied to competency profiles certifying the skills learned became common practice, career education courses preceding the selection of an occupational specialty were introduced, job search skills were added to the curriculum of most vocational programs, home economics was reoriented from a focus on home making to a focus on preparation for work and the content of many individual programs was upgraded and updated. Consequently, the data on the younger members of the NLS Youth sample and on High School and Beyond students all of whom received their vocational instruction between 1978 and 1982 is much more relevant to vocational education as it is now practiced than the Class of 1972 data analyzed by Meyer, Gustman/Steinmeier and Woods/Haney. Secondly, the labor market reward for the skills taught might be experiencing secular change. If it were, it would be important to analyze the most recent data possible. Thirdly, large samples are preferable to small samples. In the four year interval between the Rumberger/Daymont analysis of NLS youth data and Campbell et al's analysis, the number of graduates for which high school transcript data was available nearly doubled. This makes the findings in Campbell et al's 1986 and 1987 papers a more reliable estimate of vocational education's effect than those provided by Rumberger/Daymont's 1982 study and the early studies by Campbell and his colleagues at NCRVE (Mertens and Gardner 1982).

Finally, the more recent studies have much improved measures of participation in vocational education. Studies which use transcript information to define the variables characterizing vocational participation (ie. the work of Meyer, Rumberger/Daymont and Campbell and his colleagues) are

clearly preferable to studies using student reports of track and probably preferable to those using student reports of courses taken (ie. the two Kang/Bishop studies). Just as important in our view is the improvement in specification that results from allowing for diminishing returns to additional vocational courses. Clear evidence of diminishing returns can be found both in Table 1 and 2 and in the results of estimating the quadratic model. If the true relationship has strong diminishing returns, the linear additive specification will produce downward biased estimates of the effect of pursuing a vocational program of modest intensity and upward biased estimates of the effect of increasing the number of vocational courses from four to eight. Since closing down high school vocational education is an option that is receiving serious attention, the fact that occupational training programs of modest scale (3 or 4 full-year occupational vocational courses) have an extremely high payoff is a very important finding.

Footnotes

1. These estimates of the effects of vocational education were derived from Table 14 and 16 of Campbell et al (1986) by calculating a weighted average of the six coefficients on concentrator, limited concentrator and concentrator/explorer with and without a training related job and then subtracting the coefficient on academic program (transcript defined). The regressions included controls for the following: sex, minority status, handicapped, limited English proficient, test scores, grade point average, family background, attitudes, past and present college attendance, employment during high school, aspirations in 8th grade, region, rural/urban. The estimates for 1985 are taken from Table 7 of Campbell et al., 1988. The analysis of HSB data contained additional controls for presence of a spouse or child, absenteeism and discipline problems in high school. The monthly earnings models controlled for labor market experience and tenure on ones current job. The HSB model of monthly earnings also contained controls for occupation.

2. Since the individual is counted as having worked in a month even if he or she worked for only part of the month or in a part time job, the number of months worked is not the same thing as total hours worked. An average hourly wage rate could not be calculated for about 385 people who did not have a job during the time period or who gave incomplete answers to wage questions in all their reported jobs. In addition wage rates greater than $15.00 an hour or less than $2.00 were assumed to be reporting errors (e.g., waiters not reporting their tips) and so were excluded from the sample.

3. In computing an earnings maximizing combination, the unrestricted estimates in the female earning equation do not guarantee the existence of the inner solution. Consequently, the computation of the earnings maximizing mix of courses for females was based on restricted estimates which imposed a zero constraint on the coefficient for the interaction term.

4. All published estimates of the impacts of vocational education are potentially subject to selection bias. Even though these estimates are made while controlling for all measurable background characteristics, it is possible that there is some unmeasured personality trait that (a) existed prior to entry into vocational education (b) is stable and (c) has important effects on both the outcomes studied and the probability of participation in vocational education. We could, of course, be more confident of our estimates of the impacts of vocational education if they were based on an experimental design, but in the absence of such experiments policy decisions must be based on the high quality nonexperimental longitudinal studies that are available. Selection bias probably exaggerates the effect of participation in vocational education labor force participation of women and may produce downward biases in estimates of its effect on wage rates. Errors in the measurement will probably be random, so they cause downward biases in estimates of the effect of participation in vocational education.

5. This statement is subject to the following caveat. There are many differences across individuals and vocational programs in the marginal payoff to vocational course work that could not be incorporated in the models estimated in this paper. If such differences are visible to individual students and teachers and they have confidence in their local information, they should base decisions on the local information even though it may contradict one of the generalizations just made.

APPENDIX 1

SELECTING SAMPLES

The samples used in the estimation are selected by the following criteria:

1. Responded in both the first and second wave survey.
2. Did not attend college as a full-time student after leaving high school.
3. Left high school in May or June 1980.

4,327 out of the original 11,995 respondents satisfy these three conditions. The sample size is further reduced by eliminating the samples with missing values. The final numbers of samples used in each equation are as follows:

dependent variables	males	female	male and female female
wage	942	1116	2058
earnings in 81	1195	1381	2576
total months worked	1130	1355	2485

APPENDIX 2

The variables describing the student's curriculum are as follows:

Years of courses taken

Academic courses

1. Mathematics
2. English
3. Foreign language
4. History/Social Science
5. Science

Vocational courses

6. Business/Sales
7. Trade/Industrial and TEchnical
8. Other vocational courses

The control variables used in regression analysis are as follows:

Grades and Test Scores

- Received mostly A's or B's in business/office courses (self report)
- Received mostly A's or B's in trade/technical, and other vocational courses (self report)
- High school grade point average (SD = .7)
- Mathematics standardized test scores (SD = 10)
- Readings standardized test scores (SD = 10)
- Vocabulary standardized test scores (SD = 10)

Geographic region

- Dummy variable for suburb
- Dummy variable for rural (default is urban)
- 8 dummy variables for 9 census regions, New England, South Atlantic, East South Central, West South Central, East North Central, West North Central, Mountain, and Pacific (default is Mid-Atlantic)

Sex, race, ethnicity, age

- Dummy for sex (male = 0, female = 1)
- Race (white = 0, non-white = 1)
- Hispanic (Hispanic = 1, non-Hispanic = 0)
- Age (age as of May 1980)
- presence of physical handicap
- Graduated from high school

Family background

- Family income (in thousands)
- Mother's education (in years)
- Father's education (in years)
- Dummy for family income data missing
- Number of siblings
- Dummy for "parents know what their kids are doing"

Value scores and attitude toward work

- Psychological scales for self concept, locus of control, work orientation, family orientation, community orientation
- Dummy variables for enjoy work for pay, like to work hard in school
- Church attendance (scale 0 to 1)

Habits and school life

- Dummy for "read books for pleasure"
- Dummy for "read news paper"
- Scale for having difficulty in adjusting to school life
- Dummy for presence of school disciplinary problem
- Dummy for occasionally cut classes"
- Hours spent working on homework per week

Extracurricular activities

- 12 scales for participation in extracurricular activity in athletic club, cheer leaders and pep club, debate and drama club, school band, hobby club, honorary club, school newspaper, subject matter club, student government, vocational club, youth club.

Part-time student status

- Dummy for part time student after leaving high school

Work experience

- Number of hours worked for pay per week during senior year
- Number of hours worked for pay per week during summer of 1979
- Number of hours worked for pay per week during junior year

Marital status

- Dummy for married

Military status

- Dummy for active military service

APPENDIX 3

CREATION OF WAGE RATE, MONTH WORKED, AND EARNINGS DATA

The next two pages show the questions from which wage rate data are created. The respondents reported occupation and industry of the job, starting month and year, starting wage rate, average weekly work hours, ending or current wage rate, and ending or current month and year for up to five jobs they experienced after graduation (June 1980 to February 1982). Average hourly wage is defined as the total earnings during the 21 month period divided by the total work hours. The total earnings is obtained by assuming that wage rate growth is linear in time and that weekly work hours is constant in one job spell. Earnings in 1981 is obtained from the self reported yearly earning in 1981 (question is not shown). Months worked is obtained from the response to the question: "Which months did you work or serve in the military since you left high school?"

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